Light and Lighting

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Then and Now

THE close of the year is a time when most of us indulge in retrospection, as well as in planning what we hope to do in the coming year. So far as this Journal is concerned, it is impressive to realise that this issue marks the end of the 42nd year of publication. There has been great progress in the science and practice of lighting during this period, and doubtless the future will bring much more. It is interesting to note that some of the topics which engaged the pages of early issues of the Journal are still very live—for example, the subject of glare. Our endeavour in the coming year will be to give the Journal a wider appeal while maintaining a high standard of technical merit. The January number will appear with a redesigned cover, among other innovations, which we hope will enhance the value and widen the circulation.

Illumination Notes and News

The I.E.S. Register

On a number of occasions recently we have reminded members of the I.E.S. that from February 1 next all applicants for inclusion in the I.E.S. register of Lighting Engineers will be required to hold the City and Guilds Intermediate Certificate in Illuminating Engineering. For the first two years of the operation of the scheme the regulations permitted those who had been practising as lighting engineers for some years to gain admission to the Register without the necessity of taking the examination.

It is now announced by the Council of the I.E.S. that with the termination of this interim period certain alterations will also be made to the minimum period during which applicants shall be required to have been engaged in the practice of illuminating engineering. At present this period is three years, and it includes any period spent on training. The training schemes in operation at different firms in the industry differ to such an extent that it was found to be impossible to separate time spent in training from time actually spent in practice. In addition, at the time of the inception of the Registration scheme a number of I.E.S. members who had had a certain amount of experience before the war were returning from the Forces and the Society was anxious to encourage them to obtain this qualification.

As from February 1, therefore, all applicants for inclusion in the Register will be required to have been engaged in the practice of illuminating engineering for a period of not less than five years. In the case of applicants who have already obtained a recognised standard in an allied field it has been decided that the period shall remain at three years as at present. The reason for this is that some people may wish to complete their studies in, say, electrical engineering and obtain membership of the I.E.E. before specialising on lighting. It is reasonable to expect that such people will have gained some knowledge of lighting during this time in addition to having obtained a very sound engineering background. The reduction of the period in these circumstances to three years is, we think, justified.

These changes will do much to strengthen the Register, a number of us having felt that the present qualifying period is too short. It might also be expected that in the future the average age of students or trainees entering the lighting industry will be lower than at present,

Next I.E.S. Sessional Meeting In London

The next I.E.S. Sessional meeting in London will be held at the Lighting Service Bureau, 2, Savoy Hill, W.C.2, at 6 p.m. on Tuesday, January 10.

At this meeting a paper on "Discomfort Glare and the Lighting of Buildings" will be presented by P. Petherbridge and R. G. Hopkinson. The paper describes work which has been carried out in this country to obtain more detailed knowledge of the effects of glaring light sources on comfortable vision. The application of the results to problems of lighting design is discussed.

and it is as well to ensure that a lighting engineer holding a qualification issued by the I.E.S. has at least reached a reasonable age.

Joint Engineering Conference, 1951

The Councils of the Institutions of Civil, Mechanical, and Electrical Engineers have decided to hold, in London, a joint engineering conference from June 4 to 15, 1951, to coincide with the Festival of Britain which is to be held that year.

The theme of the conference will be to place on record the achievements of British engineers and will afford an opportunity for the engineers of the world to discuss the future trends of developing the great sources of power in nature for the use and convenience of man. The conference will also underline the interdependence of all branches of engineering, for none of the great developments in the last 100 years would have been possible without the constant and ever-growing co-operation of the members of the three major engineering institutions in Great Britain.

Mindful of the importance of maintaining the high standard and technical efficiency of British engineers in the future, the conference will also discuss the development of the system of education of engineers in Great Britain which, by the achievement of British engineers, has shown itself to be pre-eminently suited to the conditions in this country.

The detailed arrangements of the conference are now being prepared and will be given in a further statement.

Electrical Standards in Australia

The attention of anyone intending to export electrical equipment to Australia is drawn to the Standards Association of Australia Wiring Rules. These S.A.A. Wiring Rules receive statutory recognition in the States of New South Wales, Queensland, and Western Australia. The rules printed by the Hydro-Electric Commission of Tasmania are a copy of the S.A.A. Wiring Rules, and the Electricity Trust in South Australia also works to these rules.

In Victoria, the State Electricity Commission has regulations based on an old draft of the S.A.A. Wiring Rules, but it is understood that soon these regulations will be brought into line with the S.A.A. Wiring Rules.

Copies of the S.A.A. Wiring Rules and other Australian standards may be obtained in the United Kingdom from the British Standards Institution, Sales Department, 24, Victoria-street, London, S.W.1.

Report of N.P.L. for 1947

The report of the National Physical Laboratory on the work carried out at Teddington during 1947 has just been published by H.M. Stationery Office, price 1s. 3d. During this period the activities of the Light Division were mainly in connection with the research programme, there having been a decrease in the number of instruments submitted for routine testing.

Research on vision included further measurements of the threshold sensitivity of the eye to coloured light and on the determination of the scotopic visibility curve. In preparation for the adoption on January 1, 1948, of the new photometric units a large number of standard lamps were sent to the laboratory for remeasurement.

The work of the N.P.L. in the service of industry is not perhaps as well known as it should be. There is, of course, a close liaison between the laboratory and the research organisations of the larger firms in the lighting and other industries, but we would like to remind those firms who cannot boast a research laboratory of their own that the N.P.L. is always willing to help them with their problems. An article on the work of the laboratory will appear in our columns in the near future.

Architectural Lighting in Germany

By GERHARD ROSENBERG,
A.R.I.B.A., A.M.T.P.I.

Paulskirche, Frankfurt.

A new theatre at Weimar.

The Parliament Building, Bonn.

The gutted interior of the old Church of St. Paul was one of the first major reconstruction tasks in post-war German public architecture. It was rebuilt in 1946-47, when materials were desperately short. In many ways the design of this building has benefited by the lack of conventional materials. There are many ideas in it which are the more effectual the less they are obscured by details of finish.

One of the most striking things about the building is the way in which all services have been considered in the design from the start. They are either playing a definite part in the architectural effect, or else they have been eliminated from sight altogether, and housed in such a way that they are fully efficient without disordering the big hall of the church or even its subsidiary rooms with any mechanical installations. This applies to lighting, heating, air conditioning, telephone, amplifier system, and broadcasting arrangements. The lighting in particular is interesting.

The elliptical main hall of the church, which was at one time used as the first parliament of the German Republic of 1848, was intended as either a church or a meeting hall or even as another parliament for Western Germany. That was before the days of Bonn. Tubular lights are suspended from the ceiling, some 70 feet up, and they hang within nine or 10 feet of the floor. While the topmost lights illuminate the ceiling, the lower lights have the effect of an invisible ceiling. These lights can be switched on in any sequence desired, and the apparent size and proportion of the hall varies with the intensity and height of the lights. The ceiling can be left in darkness, and an apparently low room of rather

The interior of the reconstructed Paulskirche, Frankfurt, showing the suspended tubular lights. *(Architects :—Schwarz, Schaupp, Krahn and Blank).*

intimate proportions can be created; or the light can be switched on only in the upper tiers of lamps, which makes the apparent height of the building very considerable, and makes the people in the body of the hall feel rather smaller than they might feel in a more familiar lighting. When all the lights are switched on — and the sight of switching them on at dusk is rather thrilling, like a rain of fireworks—the large auditorium acquires a festive appearance, which the photograph does not quite convey.

A good example of semi-indirect lighting effects produced by direct light placed close to a wall is given on the photographs of the foyer in the lower floor. Structural marble columns carry the floor of the main hall, and the central space is taken up by a small meeting room. Ventilation openings separate the walls from the ceiling. The walls of this central elliptical cell are yet to be

covered with a fresco or mosaic design. The cloakroom on the bottom floor has a more conventional indirect lighting system, which compares less favourably with the ceiling lights in the foyer.

The main entrance, however, which is a narrow, very tall, funnel-shaped passage, is lighted by two tiers of concealed wall

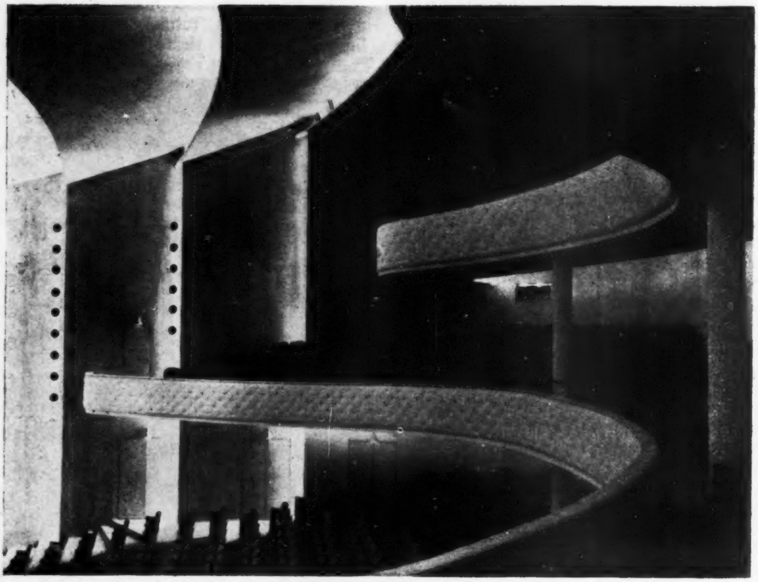
(Above). The foyer of the Paulskirche.

(Left). The foyer of the theatre at Weimar.

brackets, which give a brilliant and welcoming light. The reflection from the curved ceiling and the rough surface of the textured plaster help to obviate any uncomfortable glare. All transitions are gradual.

The effect of indirect lighting on textured surfaces is also used in a new theatre interior recently completed in Weimar, in the Soviet Zone. The architect is Professor Hartung. This theatre is clothed in silk with quilted fronts to the balconies and with the walls covered with light grey velour. The lighting is wholly indirect and integral with the design of the walls.

The new parliament building in Bonn, designed by Hans Schwippert and completed within five months of the decision to build, has many good ideas as far as lighting is



The interior of a new theatre recently completed at Weimar in the Soviet Zone of Germany.

concerned. Unfortunately, photographs are not yet available. The ceiling of the main chamber of the Lower House is divided into squares, about 30 inches each way, the sides of which are formed by a tubular lamp. Thus the daylight pattern of the ceiling is repeated at night, when the lights are switched on. The restaurant for the Members of both Houses is lighted in a very simple and charming manner: electric lamps are set in the ceiling of the restaurant, which forms a long open gallery and overlooks the Rhine. In day-time the lamps look like the pattern of a quilted cover, and at night there is an even and nearly shadowless light, punctuated by the pattern of the lamps which are not strong enough to be glaring.

When one sees how well the forethought in matters of lighting is repaid, it seems to be an obvious conclusion that lighting is one of the first things to be considered in any major architectural scheme. No amount of applied fittings can replace the harmony which an integral design of the light sources give to a building. There is no suggestion that architects in this country are neglecting this aspect of their work. The examples given above, however, show some interesting applications of lighting to building design by German architects.

CORRESPONDENCE

LIGHTING UNITS

The Editor, LIGHT AND LIGHTING

Sir,—I quite agree with Mr. W. Robinson in your November issue that it is desirable to retain "unit" for fundamental measurements. For the other purpose I see nothing wrong in "lamp holder," "lamp stand," "lamp bracket," or "lamp house"—or, where appropriate, "glow tube holder," and for the article in which the light is produced, "lamp," "bulb," "tube," or, more generally, "source."

In the difficult question of nomenclature discussed by "Dimwit," writing from a biological laboratory, I prefer lux or metre candle, as given in Smithsonian Physical Tables; alternatively, in the British system, foot-candle—but biologists invariably use the metric system, which is much the simpler when one has to explain physical terms to those whose main interest lies in other fields.—Yours, etc.,

W. R. G. ATKINS,
Marine Biological Laboratory, Plymouth.

Reinforced Concrete Lighting Columns

By W. E. BALLARD,
A.M.I.E.E., F.I.E.S.

This article briefly describes the methods used in the manufacture of concrete columns and deals with their handling, erection and maintenance in public lighting.

Contrary to general belief concrete public lighting columns have been in general use for something like 20 years, and many thousands were in service in this country before the last war. It is, however, only since the end of the war that concrete columns have really come into their own. The shortage of steel, together with a widespread desire to improve street "furniture," has, in the last year or so, tempted many lighting authorities to install them to support both gas and electric lanterns.

Construction and Finish

Most good present-day concrete columns are made in accordance with B.S.S. 1308 and have well designed mild steel reinforcements partly or wholly welded together to form a strong frame. This is placed in a steel or wood mould, depending on the number of columns to be produced, spaced usually by concrete reels from the mould walls and filled with concrete of the correct mixture. The mould is then vibrated or spun according to the custom of the particular manufacturer concerned.

In the vibrated method a device, usually electrically driven, is attached to the mould and shakes it at a predetermined frequency, the mould being vertical or horizontal. In the spun method, the mould is horizontal and revolved at high speed. Both methods aim at filling all voids and producing a good "texture."

It is claimed that centrifugally spun poles are stronger, due to a greater density. Similarly, it is claimed, the vibrated method is better since the density is uniform, whereas in spinning the larger stone works outward under centrifugal action leaving the lighter material nearer the centre. There is also a difference in peripheral speed between the large and small ends of a spinning mould. Both methods have their merits and can produce good durable columns which are normally given a rubbed cement finish or ground smooth.

The rubbed finish is obtained by rubbing by hand the whole surface with a pad or block containing wet cement and sand, subsequently removing surplus finish by means of a fine carborundum stone and water. The ground finish is, as the name implies, achieved by grinding with carborundum wheels revolving at high speed and lubricated with water.

Whereas the rubbed finish gives the appearance of natural concrete, a ground column is coloured according to the amount and colour of the natural stone at the surface. Natural stone which is used includes Hilton Gravel, Mountsorrell and Shap Granite. Where a superior ground finish is called for the surface can be given a polished effect by continuing the grinding process with finer carborundum wheels. Attempts have been made to colour concrete columns but the pigments tend to bleach in the sun or to be washed out by rain and weather. They may weaken the cement.

Brackets are invariably manufactured using the vibrated method and in steel moulds with the same finish as the shaft. Their contour prohibits any other method of manufacture.

Maintenance

Unlike metal lighting columns, which require periodical painting or metal spraying to avoid corrosion, concrete columns normally require no maintenance and take on a matured appearance characteristic of local surroundings and conditions. Both rubbed and ground finished surfaces ultimately become rough due to weathering and a gradual reduction in the amount of cement in contact with the elements.

A rubbed finished column can easily be patched in the event of damage. It is, however, almost impossible to patch a damaged ground finished column without the repair being plainly visible. Some authorities give their rubbed cement finished columns a wash down with a cement/sand

mixture every few years to preserve a clean and light appearance; others prefer to let them remain naturally coloured by the elements in harmony with the surrounding buildings.

Life

Some concrete columns have been in service for approximately 20 years under very adverse conditions of weather and atmosphere and yet appear to promise many more years of life. One well-known manufacturer gives a 25 years' guarantee and it can be assumed this period is well within the useful life.

It is assumed, of course, that columns are properly handled and erected. A deep crack produced by mishandling, etc., so that the weather can reach the reinforcements, can lead to increased cracking due to growth of rust on the steel and ultimately to serious weakening of the reinforced structure as a whole. One important point to remember about reinforced concrete is that, made correctly, it improves in strength with age.

Fig. 2. Main road column with side entry lantern.

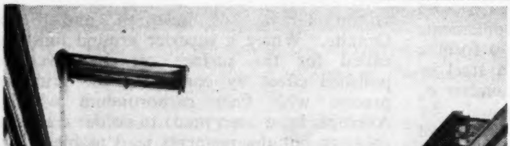


Fig. 1. Narrow-base columns shown in use in main shopping street.

Effect of Impact

The question is sometimes asked: "What is the effect on a reinforced concrete column when hit by a vehicle?"

The average reinforced concrete lighting column is extremely robust and designed to withstand normal impact shocks. It has no particular weak spot, but there is a danger of the bracket being whipped off the top of the shaft. The tying of bracket to shaft is therefore important. The effect of collision on a column depends on the weight and speed of the vehicle and to some extent on the direction and height of impact. The size

Fig. 3 *(Above)*. A bracket fixing for all overhanging types. This gives security over long life.

of the column, degree of reinforcement, shape and size of ground root, all make a difference.

It is impossible accurately to assess the effect of collision on any design of pole, although it can be safely said that the reinforced concrete pole is very resistant to impact and will rarely collapse under the most severe conditions, generally remaining more or less upright.

It is, however, clear that in erecting concrete columns sufficient concrete should be used round the ground root to give adequate support, but that it should not be overdone to the point of making the whole too rigid in the ground. Correctly installed, the column and root should " give " a certain amount on impact, the ground acting as a shock absorber.

Handling

The larger manufacturers issue clear instructions for handling and stacking their various columns to avoid undue strain which might lead to cracking. Concrete columns are primarily designed to be used in a vertical position and not as a horizontal beam. Accordingly, when stacked, attention should be paid to the positions of timber baulks, etc., on which they rest. This applies particularly to the more slender and graceful designs developed of recent years. As far as possible columns should not be left stacked on open spaces where children or hooligans can jump heavily on them as again this can lead to cracking. All good concrete columns will stand a reasonable amount of deflection, but there is a limit beyond which it is undesirable to go. Unfair handling of columns before erection can cause permanent damage, with consequent shortening of useful life.

Design

Perhaps one of the reasons for concrete columns being installed in ever-increasing numbers is the tendency for the more enterprising manufacturer to concentrate on more slender proportions and graceful lines. Lighting authorities are no longer expected to put up with columns which take up too great a share of the footpath and which restrict the passage of perambulators and pedestrians. It is now possible to employ a main road column to give a mounting height of 25 feet to light source and up to five feet projection bracket with a base compartment which will accommodate all the usual electrical gear, yet having a dimension at ground level of only 9½ inches. Such a column is illustrated in Fig. 1.

The Ministry of

Fig. 4 *(Left)*. Base of main road column showing compartment and board to which electrical services, control gear, etc. are fixed. (Door removed).

Fig. 5 *(Below)*. Main road column carrying overhead electric lines.

Transport on certain main road schemes insist on columns being of a design approved by the Royal Fine Art Commission, and several manufacturers are now producing such designs. These usually rely on simplicity of line rather than intricate decorative treatment. Brackets are available to take top entry (pendant) or side entry lanterns (Fig. 2).

The method of securing brackets to columns varies with the manufacturer. In general a steel tube extends upwards from the shaft on to which the bracket is lowered and secured by set screws, or the weatherproof door of galvanised steel, or in certain cases concrete, to match the column and is fastened by a suitable tamper proof type of lock. The root has a cable slot below ground level and the underground cable passes through it into the pole and up to a suitable termination such as a sealing chamber located at the bottom of the switchboard. The internal electric wiring consisting usually of T.R.S. cable, with an earth wire of adequate size, is run up the centre bore of the column shaft and through the bracket to the lantern. Where overhead lines are used, the

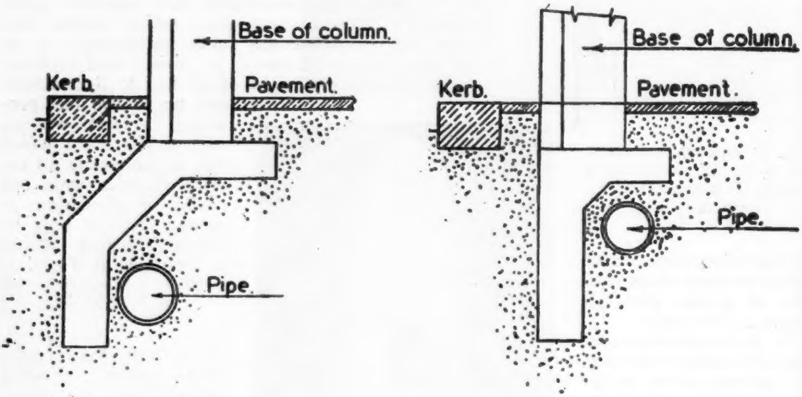
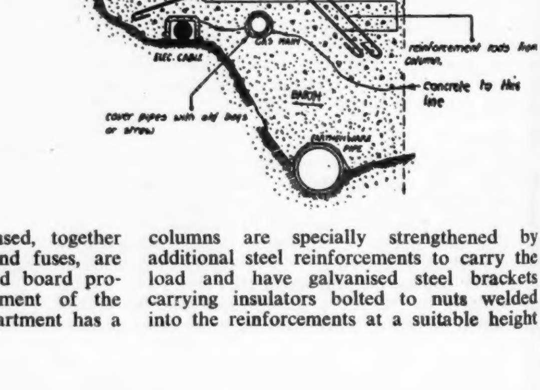


Fig. 6. Examples of special roots to avoid obstructions.



main steel tube running the full length of the bracket is extended downwards and locates in a steel reinforcing tube in the top of the shaft. A patented design embodying in addition a tension bolt device to give greater security is depicted in Fig. 3.

Electricity or Gas Supply

In the case of an electric installation, the electrical gear, including choke or transformer and capacitor when discharge lamps are used, together with time switch or relay and fuses, are generally mounted on a wood board provided in the base compartment of the column (Fig 4). This compartment has a columns are specially strengthened by additional steel reinforcements to carry the load and have galvanised steel brackets carrying insulators bolted to nuts welded into the reinforcements at a suitable height

above ground. A weatherproof cable entry is also built in at about the same level and the wiring taken down to the base compartment and then back again from the gear located there to the lantern as before. An example is to be seen in Fig. 5.

To enable a concrete pole manufacturer to offer a suitable design to carry overhead lines, he requires all relevant details including the number and size of conductors, maximum length of spans and a plan of the overhead line route.

Where gas is to be used, a door and base compartment is not always necessary, especially in the case of Class " B " columns. The standpipe is brought up the column from its junction with the service pipe and at its top end screwed via a reducer to a tube running through the bracket to the lantern.

Special Requirements.

It often happens in old thoroughfares that under the footpath there exists a maze of pipes, cables and other obstructions which make it impossible to locate a column with normal root where good practice dictates. In such situations it is usually possible to overcome the difficulty by the use of a special root as illustrated in Fig. 6. The pole maker to do his job properly requires to have a detailed section of the ground under the footpath to the full depth of the root. The root is then designed to suit, and the main reinforcements of the column are carried right through the special root to give it the necessary strength.

Sometimes poles are required to be fixed to a bridge where the depth of root available is too little, and this can be overcome by making the root short with the main reinforcements left protruding. These can then be screwed and with nuts bolted to steel plates for securing to the bridge structure. Another method sometimes adopted is to use a concrete platform cast integral with the column for fixing in a similar manner. In all cases it is best to seek the advice of the manufacturer.

Concrete columns can usually be made to carry raising and lowering gear, the winch as a rule being fitted inside the base compartment.

For situations where centrally suspended lanterns are to be supported or where it is essential for a column to be mounted at the back of a footpath, bracket projections up


Fig. 7. Class 'B' column with pendant lantern


Fig. 8. Narrow based column in erection.

to 14 feet on a standard Class "A" column are obtainable.

Erection and Installation

The erection of concrete lighting columns presents a little more difficulty than metal columns, as greater care has to be exercised to avoid damage. Generally speaking, Class "A" columns, which weigh anything from 13 cwt. to over a ton, are best installed using a suitable crane. Brackets can often be fixed before the operation (See Fig. 8).

The method of erecting Class "B" columns varies, some authorities using a crane and others managing quite well without. A lot depends on the weight of the columns, which can vary from 4½ to over 8 cwt.

The method of concreting the ground root together with the amount of concrete used is a matter of experience, and depends largely on the type of soil and whether the columns are to be set in a grass verge or a paved footpath.

Certain specialist firms are now able to relieve authorities of the responsibility of erecting their columns and having the right equipment and skilled men can undertake the work most expeditiously and at a reasonable cost. Those authorities, however, who wish to install their own columns can always obtain advice from the manufacturers.

Future Developments

The tendency in the future will almost certainly lie in the production of even stronger columns with more graceful and slender lines. Much has been made about the possibilities of pre-stressed and post-stressed concrete. In its simplest form this means the replacement of mild steel rods normally used as main reinforcements with high tensile steel wires, and, in the case of pre-stressing, tensioning them before pouring the concrete into the mould. When the concrete has set, the wires are cut at both ends and the whole column is then in compression by the bonding of the steel to the concrete. In post-stressing, the wires are arranged to slide in sleeves or prepared holes, are tensioned after the concrete has set and secured to anchor plates at the ends. Under consistent loading conditions these methods may offer advantages, but experience is still being gained in their application to column construction and design. The peculiar requirements of street lighting will probably delay its application to this field, although certain manufacturers are working on development in that direction.

Southend-on-Sea Illuminations, 1949

Sea-front lighting by the Eastern Electricity Board

A £5,000 contract for the provision of an Illuminations Scheme in the sea-front area of Southend-on-Sea was secured by the Eastern Electricity Board in April of this year following the submission of various proposals to the Corporation. The Board's original proposals catered for an expenditure of some £10,000, but after consideration by the Council it was decided to limit the expenditure to £5,000, and a revised scheme within this limit was submitted and approved.

(Left). West Cliff, Westcliff-on-Sea.

(Below). Sunken Garden, west of Pier and Pier Pavilion.

The revised proposals allowed for strip lighting along both sides of the promenade from a point east of the Kursaal to Shorefields, a distance of approximately two miles, together with coloured flood-lighting of the trees, shrubs and gardens on a section of the West Cliffs at Westcliff-on-Sea, for the period September 7 to October 19 inclusive. The scheme covered all charges in connection with the repair of equipment, erection standby, maintenance, unit charges, dismantling, etc.

Most of the equipment necessary for this scheme was already in the possession of the Corporation, having been purchased for pre-war illumination schemes. This assisted materially in enabling the Board to provide what is considered to be a good display for the money allowed. Owing to damage sustained during storage, much of the equipment needed testing and repairing; this work was commenced in April, lasting some 13 weeks.

Erection was commenced towards the end of July, and an average of twelve men were engaged on this work until the official switching-on date, September 7, during which period some 13,000 yards of strip lighting was erected on 240 scaffold poles and street lighting columns, 650 flood-lanterns and troughs installed on the cliffs, 20,000 yards of temporary mains and sub-mains run out, and the whole tested and connected to 18 switching points supplied from five sub-stations. The total number of lamps installed was approximately 15,500, comprising 11,100 15-watt and 3,450 7-watt for the strip, 600 30-watt "striplite" lamps for troughs, and 350 lamps of various wattages

between 100 and 1,000 for the flood-lanterns, making a total load of some 400 kw.

The selection of suitable colours and focusing of lamps on the West Cliffs necessitated working in the early hours of the morning on several occasions in order to avoid a preview of the scheme being given to the visitors and residents.

It had been agreed that an official switching-on of the illuminations should be carried out by His Worship the Mayor of Southend, Councillor S. J. Bates, on September 7, at 8.15 p.m., and the position selected for this ceremony was a section of the West Cliffs. In this connection the Board provided a master switch linked up with the various switching points so that the operation of this master switch would result in all switching being synchronised. As the time approached for the master switch to be operated, the tension amongst the members of the Engineering Department of the Board responsible for the final arrangements was noticeable, in spite of numerous earlier tests to ensure that no "hitch" would occur. The operation of the switch by the Mayor, however, produced the desired results.

It should also be mentioned that the Corporation's Pier and Foreshore Department also provided a scheme of illuminations on the pier in conjunction with the Board's scheme, the switching of which was also synchronised for the official switching-on ceremony.

From September 7 to October 19, the official finishing date, the maintenance of the scheme was undertaken by four men, working under an engineer, who were responsible for the repair and adjustment of all equipment, replacement of lamps and colour media, attention to any defects, general standby attendance, switching, etc. The switching hours were from dusk to 10.30 p.m. from Sunday to Thursday (inclusive) and 11 p.m. on Friday and Saturday.

Judging by the number of people and vehicles on the sea front during the lighting hours, the scheme was undoubtedly a great success, and at week-ends the stream of private vehicles almost reached congestion point. Large numbers of coaches made special trips from London and places as far afield as Peterborough, Northampton, Oxford and Southampton, whilst special trains brought people each evening from the London area. It was necessary on occasions to extend the illuminations beyond the normal switching-off time on account of the crowds still abroad at that late hour.

The disconnection and removal to store of the equipment occupied the time of twelve men for some two and a half weeks, and was commenced on October 20. The work is now completed, including the final reinstatement of footpaths, etc., on the sea front and cliffs. Plans are already being made for a still better scheme for 1950.

New London Tube Car Design

The problem of designing a tube car within the limited headroom available is a difficult one, and has in the past resulted in a low sight line at the top of the windows so that passengers standing in the car cannot see out without stooping.

London Transport has, therefore, converted a tube car of the present standard (1938) pattern, on an experimental basis, to provide a high window line by carrying the glass of the windows round into the roof to the level of the top of the doors. The doors themselves have also had their windows extended upwards.

The new windows are glazed in three pieces. The upper piece is curved to the roof contour, the lower piece is straight. Between the two is left a space filled by a tilting ventilator glass. Since all the horizontal edges at the ventilator region are frameless for full vision, the ventilator glass is curved in the vertical direction to provide enough stiffness to withstand rough handling.

The glass panels in the sliding doors have likewise been extended to the top of the doors in two pieces, which butt together at the springing point between the curved and straight portions. The butt joint is made with light-weight metal channels. Later it may be found possible to substitute single pieces of glass.

An innovation is that the fixed glass panels of the car body are clipped to the outside of the car by their corners and butt on to sorbo rubber strips. This construction is experimental, and is intended to overcome certain difficulties experienced with water lodging on the upper edge of the car panel, against which the glass is usually secured, and leaking down between the steel and the glass, causing corrosion. It also permits some latitude in curvature for the roof glasses compared with the roof contour.

The new arrangement of windows will be kept under observation in various climatic and running conditions, and data collected towards a new car design for future use, in which the arrangement can be carried out in a way not attainable in an alteration.

Colour Adaptation

It is a matter of common observation that the colours of the objects in a room lit by such sources as the tungsten filament lamp seem to differ from their appearance by daylight much less than would be expected, having regard to the very considerable change in the spectral distribution of the illuminant. Apart from a few sensitive tints, we are generally unconscious of any change at all unless our attention is specially directed to it, and the familiar double booth, with coloured ribbons illuminated on one side by an artificial daylight and on the other side by ordinary tungsten lamps, is no demonstration of the appearance of coloured objects under any particular illuminant *when the observer's eye is adapted to that illuminant*.

Several investigators have carried out experiments to determine what is, in fact, the extent of the subjective colour change brought about by various illuminants under such conditions, and at the meeting of the Colour Group on November 2, at the Institute of Ophthalmology, Dr. A. A. Kruithof, of Philips Research Laboratories in Eindhoven, gave a lecture entitled "Some Experiments and Considerations Concerning Chromatic Adaptation." He described much of the work which he and the late Dr. Bouma had carried out, and some account of which will be found partly in Dr. Bouma's book, "The Physical Aspects of Colour," and partly in a paper by Dr. Kruithof in Philips Technical Review (Vol. 9, 1948, p. 257).

For his experiments Dr. Kruithof used one series of Ostwald colour cards (the n-c circle) consisting of 100 samples of graded hues with somewhat less than the maximum saturation. An observer was presented with these in a perfectly random order, and was asked to name them on a specified system of colour names containing six hue names, each associated with a set of five qualifying adjectives. The illumination was maintained at 14 lumens per sq. ft., and various illuminants, in addition to daylight and tungsten light, were used. The observer was well adapted to the illuminant, and the samples were viewed against an extended white background.

The results obtained were surprisingly definite; an observer showed a maximum spread, in his naming, of one step in either direction when making the trials on several different occasions under the same illuminant. The changes produced by a change of illuminant from daylight (actually C.I.E. Standard Illuminant C) to tungsten were also unexpectedly small, the differences being generally one step or less except in the purples when it was generally two steps.

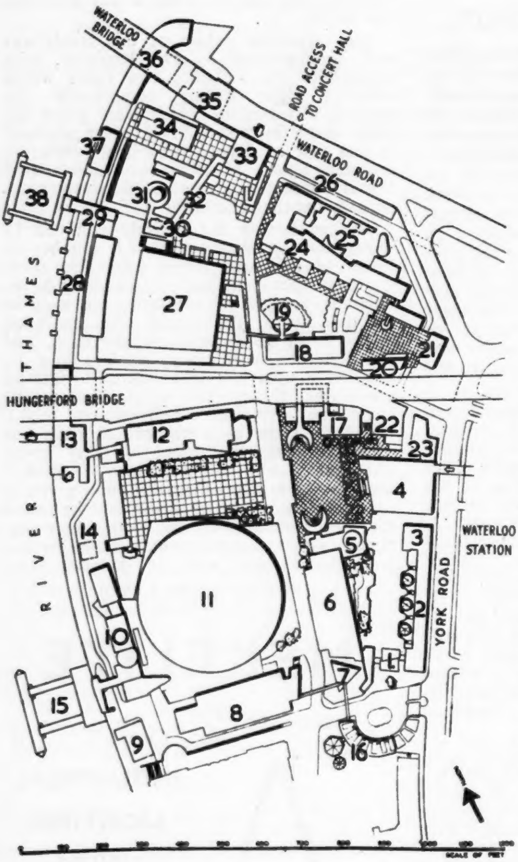
The surprising nature of this result was well demonstrated by Dr. Kruithof, who showed to the audience two cards which reflected light having respectively the spectral distributions which were given the same name by an observer when adapted, in one case to daylight and in the other to tungsten light. It seemed incredible that colour adaptation could so effectively compensate for the difference.

The work was not entirely confined to daylight and tungsten light. A number of forms of discharge lamps were also used, and the experiments were extended to cover different degrees of saturation as well as different hues. The results were exhibited in the form of chromaticity diagrams, and Dr. Kruithof went on to explain how he and Dr. Bouma had endeavoured to find an underlying theory on which the results could be explained, and which might, therefore, serve as a theoretical basis for predetermining the effect of any given illuminant. For this purpose he at first used the three fundamental stimuli given in the literature of colour vision, but he found that the results obtained in this way disagreed with the experimental results by too large an amount, and he deduced three

(Continued on p. 358)

Festival of Britain, 1951

South Bank Exhibition



The Festival of Britain, to be held from May to September, 1951, will be a nation-wide demonstration of Britain's leading achievements in the arts, sciences, technology, and industrial design. The centrepiece of the Festival will be the exhibition on the South Bank of the River Thames.

The exhibition will not be a "trade fair," for industries or businesses will not be able to buy exhibition space. But because the manufactured exhibits will be selected for the credit they will bring to British industry, the exhibition will powerfully reinforce our export drive. The scientific and engineering displays will be similarly selected on the grounds of their relevance to the story of British achievement. Thus,

1. Canopy over entrance.
2. Information, Post Office, etc.
3. Restaurant.
4. Entrance from Waterloo Station, Escalator Hall for underground below.
5. The land of Britain.
6. Country.
7. Natural Resources.
8. Industry.
9. Restaurant (the subject of a competition).
10. Sea and Ships.
11. Dome of Discovery.
12. Transport.
13. Restaurant and Entrance from Bailey Bridge.
14. Vertical Feature (the subject of a competition).
15. Pier.
16. Administration and Entrance from Chicheley Street.
17. The People of Britain.
18. Character and Tradition.
19. Cafe.
20. Film and Television.
21. Telecinema.
22. Locomotive Exhibit.
23. Administration.
24. Homes and Gardens.
25. Creche.
26. Administration and Stores.
27. LCC Concert Hall.
28. Seaside.
29. Restaurant.
30. 1851 Pavilion.
31. The Shot Tower.
32. Bridge to LCC Concert Hall.
33. Entrance from Waterloo Bridge. New Schools Exhibit below.
34. Cafe.
35. Health.
36. Restaurant.
37. Sport.
38. Pier.

the South Bank Exhibition will be mainly concerned with those contributions in science, technology, and industrial design which can be illustrated by displays and in which Britain's prestige stands highest.

The visitor to the South Bank Exhibition will find a concise presentation of only the most significant aspects of contemporary British science, technology, and industrial design, and will be encouraged to visit other parts of the country and to make contact with the industry itself.

The background, against which manufactured goods and scientific displays will be shown, will be the living working world of to-day, a particular aspect of which gives the title to each pavilion. Thus displays and exhibits will not, as has happened at other exhibitions, be grouped in sections devoted exclusively to particular trades, industries, or sciences.

To ensure the proper representation of science and technology, a great number of our leading scientists, industrialists, engineers, and technicians have been consulted. All the factual material on which designs will be based, has been provided by the country's acknowledged experts. Sixteen specialist panels, whose members are all authorities in at least one of the main branches of science, advise the Council of Science and Technology on the balanced selection which has to be made from the enormous range of British achievement.

The selection of all the currently manufactured exhibits, which will illustrate the many selections, is the responsibility of the Council of Industrial Design. All selections for exhibition will be discussed with specially appointed panels representing the industries concerned.

Among the most interesting features of the exhibition will be the Dome of Discovery. This will be the most striking building of the South Bank, and will be the largest dome in the world—with a diameter of 365 ft. and a height of 97 ft. Its material, aluminium, will be as typical of this generation as was sheet glass and cast iron of the 1850s, and its shape and construction will be as arresting in 1951 as was the Crystal Palace 100 years ago. The story to be told in the Dome of Discovery is British pre-eminence in discovery and exploration, not only by land and sea but into the very nature of the living world and universe. Thus, ranged alongside the achievements of such men as Cook and Livingstone, will be displayed the discoveries of British scientists such as Newton, Darwin, Faraday, Thomson, and Rutherford, without which so

Model of the Shot Tower.

much that is illustrated elsewhere in the exhibition would not have been possible. In all sections of the Dome, it will be made clear how the initiative in exploration and discovery remains with the British, who continue their researches aided by new ideas and new tools largely provided by science.

The shot tower, which is a prominent London landmark, will be incorporated in the exhibition. Its base will contain a small display on the history and future development of the South Bank of the Thames. Its summit will be used as a lighthouse and to mount the aerial of a radio telescope.

There will be a small section where the British contribution to the development of illumination will be shown by displays, partly historical, portraying artificial lighting. Electric and gas lamps and fittings will be shown here. Except for the new L.C.C. Concert Hall, all main buildings are to be temporary structures. They will be constructed of a wide variety of materials including steel, concrete, brick, wood, asbestos, glass and aluminium.

Three other supplementary exhibitions, two in London and one in Glasgow, will deal more in detail with architecture, science and heavy engineering respectively. The amusement section normally associated with any large exhibition will be in Battersea Park.

New Lighting Installations

Lighting in a Shoe Factory

The operation of cutting out the pieces of leather to form a shoe is known in the footwear industry as "clicking." Considerable experience is required to make the most economical use of the material and select the best portions.

During the recent extension and redecoration of the Clicking Room at Moccasin Works, the Northampton factory of Messrs. Padmore and Barnes, Ltd., the whole room has been relighted with fluorescent lamps in trough reflector fittings.

Most of the work of cutting out the leather is done manually, but presses are employed for certain types of work, and a production line of these machines receives a service illumination of 70-80 lumens per sq. ft. from one-lamp reflector fittings containing 5 ft. 80-watt Natural-colour fluorescent lamps. Other fittings of similar design are used over many of the benches, where the illumination is between 50 and 65 lumens per sq. ft. Good lighting of the leather is essential for the "clickers'" work so that flaws and inequalities of texture can be detected and avoided when cutting out. In this respect, also, the colour of the light is important, and experience has shown that the operatives are fully satisfied with the colour rendering of the leather as seen under the Natural lamps.

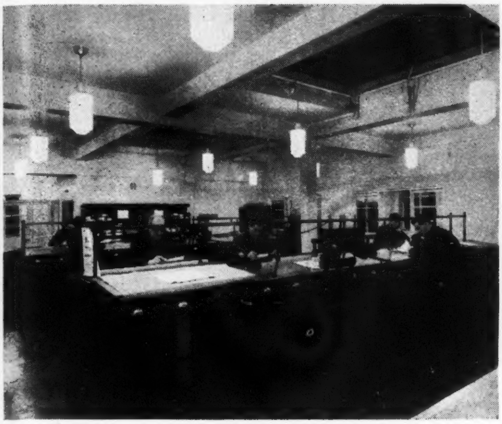
The fittings are the G.E.C. F.62004 pattern with top aperture for upward illumination. This has ensured good roof lighting, which, combined with a decorative scheme carefully selected to blend with the fluorescent lamp colours, contributes to the cheerful appearance of the room as a whole.

Natural-colour Osram lamps in two decorative fittings have been used also in the Samples Room at the factory, where they provide general lighting as well as illuminating the interiors of showcases. The fittings are supported over the showcases on decorative brackets designed and made in the factory.

Concealed lamps of the same colour are used to light a display feature at the end of the room. The Natural lamps have been accepted as equally satisfactory for showing off the finished product and aiding work on the leather in early stages of production.

The contractors for the Moccasin Works installation were Messrs. A. L. Baker, of Northampton.

Some of the cutting-out benches, with a machine production line beyond, at Moccasin Works, Northampton.



Tungsten lighting in the office of the Royal Mail Steamship Company at Victoria Docks. Altogether some 56 fittings were used in the various offices

Lighting in a Swimming Baths

An installation of fluorescent lighting equipment has recently been completed at the Caledonian Road Baths, London, in connection with the modernisation of the whole of the lighting system. In addition to the equipping of the first and second class men's and the women's swimming baths with fluorescent fittings, the wash-house has also been similarly treated. In so far as the wash-house is concerned, the re-lighting scheme is an integral part of a plan for complete modernisation, including the replacement of the whole of the machinery by up-to-date plant.

Five feet, 80-watt Ekco-Ensign fittings were used throughout the installation, which was carried out by the London Electricity Board.

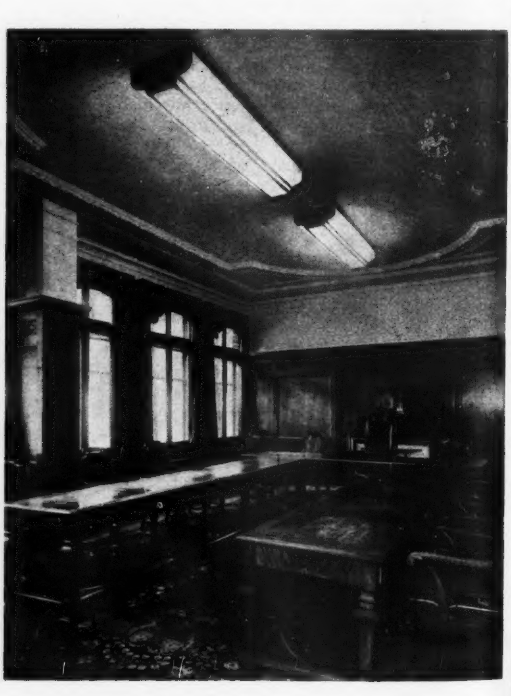
Office Lighting

A scheme of fluorescent lighting in the offices of the Westbourne Park Building Society, London, has been planned in conformity with the existing architectural features of every department. Notwithstanding the variety of fittings used, however, a

Fluorescent lighting at the Caledonian Road Baths, London.

(Above). Lighting in the Banking Hall of the Westbourne Park Building Society.

(Below). The Board Room of the Westbourne Park Building Society.



general average level of illumination of 17/20 lumens per square foot—according to the degree of detail involved in the work of the respective departments—has been achieved.

Particularly noteworthy are the special fittings in the Board room and secretary's office. These fittings, each accommodating four 5 ft. 80-watt fluorescent lamps, have specially treated "Perspex" panels which diffuse the light without seriously lessening its brightness. The clean lines of these large fittings avoid any impression of clumsiness, and they blend well with the general style of the furnishing in the rooms in which they are installed.

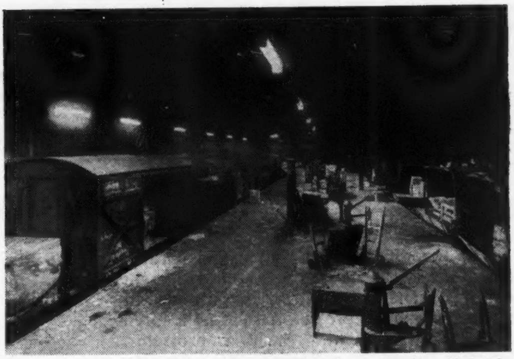
In the general offices, including the typing section, where maximum light with minimum distraction is required, bare lamp fittings, each with a single 5 ft. 80-watt lamp, are used. The staff in these rooms are placed so that in their normal working positions they look along, rather than across, the lamps.

"Perspex" diffusing covers are used on the units installed in the Banking Hall. These house either one or two 5 ft. 80-watt lamps, according to their siting. Thus, over the tellers' and counter clerks' positions, twin-lamp fittings are used, with single-lamp units elsewhere in the Hall providing adequate illumination for visitors and general purposes.

The entire scheme, involving a total of 106 fittings, was planned by the B.T.H. Co., Ltd., and the electrical installation work was carried out by Messrs. R. Clay, Ltd., Watford. The Board Room illustrated below, is an example of the design of special fittings to suit particular surroundings, whilst the lighting of the Banking Hall, shown above, illustrates the use of suitable standard fittings for interiors of this kind.

Lighting at Nine Elms

Much study has been devoted in recent years to methods of speeding up the transit of goods by rail, particularly of those small consignments in which the general public is most directly interested. Satisfactory working conditions at goods sheds are a fundamental necessity whatever other measures may be adopted, and experience has shown how much can be contributed in this direction by efficient lighting, which not only makes the work itself easier but creates an atmosphere that is a stimulus to effort. The importance of lighting is emphasised further by the fact that large depots are open throughout the 24 hours, so that work goes on during the hours of darkness all the year round.



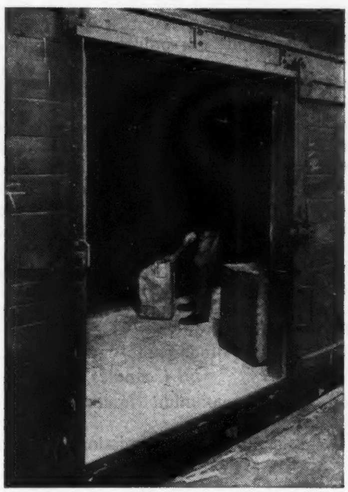
Dock at Nine Elms Goods Depot, Southern Region, British Railways, with cold cathode lighting from fittings specially designed to illuminate the interiors of vehicles.

A trial installation of cold cathode lighting, using fittings of special design, is now in use in a general merchandise shed at the British Railways (Southern Region) Nine Elms Goods Depot, London. The fittings were designed by the General Electric Co., Ltd., in conjunction with the Lighting, Water and Heating Section of the Civil Engineer's Department, Southern Region. Instead of the three tubes being mounted in the same plane as in the standard three-tube industrial fitting, the central one is lower than the outside tubes. As a result all three tubes can contribute without obstructing each other to lighting objects at platform level on both sides of the fitting.

The present installation comprises 19 of these fittings arranged in a single line on both platforms and across the end of one dock in the shed. Each contains three Osram Intermediate cold cathode tubes. The fittings are mounted at 18-ft. centres at a height of 12 ft. 6 in., which is higher than the previous tungsten lighting fittings and reduces risk of damage when long objects such as pipes or conduit are being handled on the dock. Only two bolts have to be undone to release a fitting for maintenance, and the electrical connection is broken by removing a socket connected to the shed wiring by a length of cab-tyre flex.

As a result of the special arrangement of tubes, light is thrown well into the interior of covered rail and road vehicles. Fittings are spaced so that both ends of the interior of box wagons are lit up by the pair nearest to which they are standing. No portable lighting inside the vehicles is needed by staff engaged in loading or unloading.

Road vans and drays back up at right angles to the dock along one side of the shed. The light is thrown right to the back even of 15-ft. covered drays, both rows of fittings contributing in this instance and demonstrating the build-up of light obtainable in a shed equipped throughout in this manner.



Penetration of light into the interior of covered rail wagons.

Problems in Illuminating Engineering For Students

By S. S. BEGGS, M.A., F.I.E.S.

4. The 'Parallel Beam' Projector.

The theoretical point source and parallel beam often cause great confusion of thought and misunderstanding of the performance of the narrow angle projector, such as a torch or a car headlight. Such a projector, whether using a reflecting or refracting optical system, obeys the same fundamental laws as any other light source or lighting fitting; the difficulty arises from the impractical nature of those abstract ideas, the point source and the parallel beam. The true point source has no dimensions, and must therefore, have infinite brightness to have any intensity or flux emission; these concepts have no real meaning, since every real source has a finite size and brightness. So we can forget the parallel beam, and its attendant difficulties of mathematical abstraction. In the projector, the mirror or lens becomes the secondary source, apparently emitting light, but differing from any ordinary source of light in one important respect, namely that the angle within which light is emitted is very restricted, and is different for different points on its surface. The cone of rays leaving any point of the mirror or lens can be calculated by the ordinary laws of geometrical optics. From any direction lying within this cone that point of the optical system will appear bright; from any direction outside the cone it will appear dark. Since the direction of the axis of the projection system lies within all these cones, the whole of the reflecting or refracting surface will appear flashed in this direction, and the intensity will be a maximum. The brightness of the flashed area is that of the source, reduced by a factor equal to the reflection or transmission factor for the system. By our fundamental laws, therefore,

$$I_{max} = kBA \text{ candles,}$$

where I_{max} = maximum intensity of the projector,

k = reflection or transmission factor of the system,

B = brightness of the source, in candles per unit area,

and

A = area of projection of optical system on a plane normal to its axis, in the same units of area.

The outermost rays of the beam will be those of the cone of greatest angle. For a mirror (whatever its overall contour) the angle of the reflected cone of rays at any point is the same as that of the incident light, which is the angle subtended at the point by the outline of the source as seen from that point. The rays of maximum divergence therefore come from the point of the mirror at which the subtense of the source is greatest. Note that this is not always the point nearest to the source, as it depends on the shape of the source. For a lens the determination of the cone of greatest angle in the general case is more difficult, but usually it will be at the centre of the lens. As no deviation of the rays occurs at the centre, the divergence is then again equal to the subtense of the source at this point.

The mathematical theory of the parabolic reflector need not be known in detail, but there are two very important deductions from the above considerations which generally apply in practice when the source is at the focus:

(1) The maximum intensity depends on the brightness (but not size) of the source and the diameter of the mouth of the reflector (but not its focal length), and

(2) the divergence of the beam depends on the shape and size of source and the focal length of the reflector (but not the size of the reflector).

If the source is not at the focus, the direction of any reflected ray may be determined by the ordinary laws of reflection. It is useful however, to remember that a ray coming from the *direction* of the focus will be reflected parallel to the axis, while one in-

The first article in this series appeared in Vol. XLII No. 9, September, 1949.

cident at any point parallel to the axis will be reflected towards the focus.

Question 5 (1946)

Design a parabolic floodlight to give the following performance with the lamp described:—

Diameter of spherical light source = 1.05 *in.*
Candle-power of lamp in all directions = 1,200 *candles.*
Maximum divergence of any part of beam reflected from mirror = 5 *deg. to axis.*
Maximum candle-power at centre of beam = 310,000 *candles.*
Effective reflection factor of mirror, including allowance for obstruction and error in contour = 0.6.

Answer

The brightness of the source $B = \dfrac{1{,}200}{\pi/4 \times (1.05)^2}$ candles/sq. in.

If D is the diameter of the mouth of the reflector in inches,

Max. intensity $I_{max} = kBA = k.b.\frac{\pi}{4}D^2$ candles.

Hence,

$$310{,}000 = 0.6 \times \frac{1{,}200}{\pi/4 \times (1.05)^2} \times \frac{\pi}{4}D^2$$

and

$$\underline{D} = 1.05 \sqrt{\frac{310{,}000}{1{,}200}} = \underline{16.0} \text{ (approx.).}$$

With a spherical source at the focus, the cone of rays of maximum divergence comes from the pole of the mirror, and is bounded by the tangents from this point to the spherical source. Simple geometry shows that if r and f are the radius of the sphere and the focal length of the parabola respectively, the angle α which these rays make with the axis is given by

$$\sin \alpha = \frac{r}{f}.$$

For the required floodlight, $\sin 5° = 1.05/2f$

$$\text{Hence } \underline{f} = \frac{1.05}{2\sin 5°} = \frac{1.05}{2\text{x}.0872} = \underline{6.0}$$

The desired reflector must therefore be of focal length 6 in. and have a diameter of 16 in.

Question 6 (1948)

A 1-*in. diameter disc source of brightness* 1,000 *stilbs is placed at the focus of a specular parabolic reflector, normal to the axis. The focal length of the reflector is* 4 *in., diameter* 16 *in., reflectivity* 0.8. *Calculate the axial intensity and beam spread.*

With the aid of diagrams show what would happen if the source were moved away from the focus along the axis in either direction.

Answer

(i) Axial Intensity and Beam Spread.

The brightness of the source $B = 1{,}000 \times (2.54)^2$ candles/sq. in.

Hence,

$$\underline{I_{max.}} = 0.8 \times (\pi \times 8^2) \times (1{,}000 \times 2.54^2)$$
$$= \underline{10^6} \text{ (approx.).}$$

For a disc source at the focus and normal to the axis, the rays of maximum inclination to the axis actually come from a point on the mirror close to, but not quite coincident with, the pole. However, for practical purposes the inclination will not be significantly different from that (α) of the rays reflected at the pole. If d is the diameter of the disc

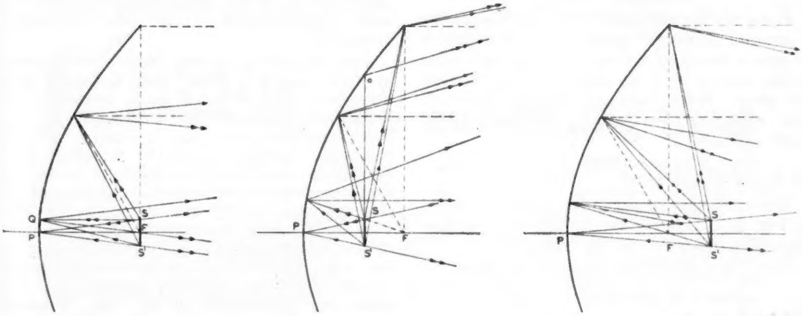


Fig. 2.

and f the focal length of the reflector (see Fig. 2 (a)),

$$\tan \alpha = \tfrac{1}{2}d/f.$$

For the given reflector, $\tan \alpha = 0.5/4 = 0.125$,

$$\text{whence } \underline{\alpha = 14\tfrac{1}{4} \text{ deg.}}$$

Thus the axial intensity of the reflector is 1,000,000 candles, and the total beam spread is 28½ deg.

(ii) Formation of Beam as the source is moved away from the focus.

In the reflector described, the focus lies in the plane of the mouth of the reflector. Thus, when the disc source is at the focus, the rays of maximum divergence come from near the pole. (Note that in Fig. 2 (a) the ray from S incident at Q, which is reflected in the direction QF, is more inclined to the axis than the rays PS, PS1, reflected at the pole of the reflector). As the outer edge of the reflector is approached, the inclination of the rays decreases, until it is zero at the rim. The reflector appears completely flashed only from the direction of the axis.

When the disc source SS1 is moved away from the focus F (see Figs. 2 (b) and 2 (c)), the rays from the edge of the mirror diverge, crossing the axis first if the movement is away from the pole P. The reflector ceases to be flashed completely, from any direction; the maximum intensity decreases and the beam spread increases rapidly. (It can be shown that the maximum intensity is theoretically proportional to $\tan^2 A/4$, where A is the total angle SFS1 subtended by the disc at the focus of the parabola). The outer edge appears dark from the direction of the axis, and the point of the mirror contour giving rise to the reflected rays of greatest divergence tends to move away from the pole.

Question 7 (1947)

Show the approximate prism formation for a circular prismatic plate 12 *in. in diameter to give a beam of minimum divergence from a disc source of* 1 *in. diameter* 6 *in. behind the glass. What intensity and spread would you expect if the source brightness were* 1,000 *stilbs*?

Answer

(i) Prism Formation

The approximate prism formation is shown in Fig. 3, which represents the cross-section through a diameter of the plate.

The plate will most suitably be plane on the side to face the source and have circular prisms on the outer face, of gradually increasing angle. The working face AB of each prism will be such as to direct parallel to the axis the ray from the centre of the source incident on the prism, as this will give minimum divergence of the beam. (The face AB may be curved, but this is a refinement). The return face BC would be approximately parallel to the ray in the glass, to avoid loss of light at this face.

Fig. 3.

(ii) Intensity and Spread of Beam

Allowing for the dark rings formed by the return faces BC, approximately 80 per cent. of the area of the plate will appear flashed, and its average brightness will be approximately 80 per cent. of that of the source. Hence the maximum intensity is given by

$$\underline{I_{max}} = 0.8 \times 1{,}000 \times 0.8 \times \pi \times (6 \times 2.54)^2$$
$$= \underline{4.7 \times 10^5}$$

The emergent rays of greatest inclination to the axis are fairly obviously those which pass through the centre of the lens from the outer edge of the disc source. These emerge undeviated, and simple geometry shows that their inclination α to the axis is given by

$$\tan \alpha = \tfrac{1}{2}d/f = 0.5/6 = \underline{0.08\dot{3}},$$

whence $\underline{\alpha = 4\tfrac{3}{4} \text{ deg.}}$

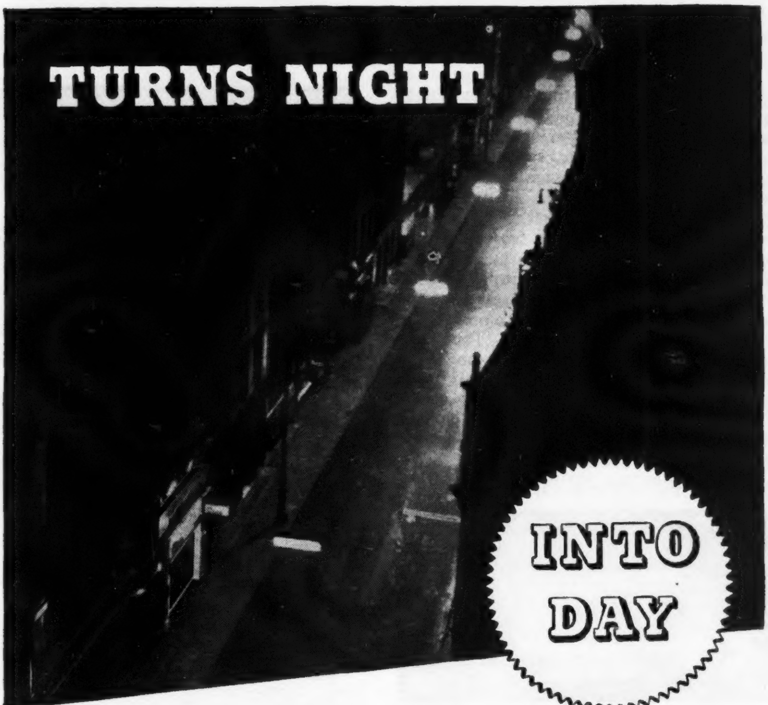
Thus the intensity I_{max} of the beam is approximately 470,000 candles, and its total divergence (2α) is 9½ deg.

Colour Adaptation

(*Continued from p.* 349)

other fundamental stimuli, which gave agreement with the experiments but differed quite considerably from those generally accepted.

The discussion on the lecture took place in two stages. After Dr. Kruithof had described the practical work, members of the Group asked questions regarding certain experimental details, and it was in reply to one such question that Dr. Kruithof said the work was being extended to include a larger number of observers. The theoretical side of the work was attacked by Dr. Vickerstaff, who maintained that the particular fundamental stimuli found to give the best agreement with the experimental results must of necessity depend on the reflection characteristics of the Ostwald colour cards used for the tests. This, however, was denied by Dr. Kruithof and by other members of the audience.



WE are proud to announce that as a result of our brilliant success in Bond Street and Kingsway, many other famous thoroughfares in London and elsewhere are being switched over to modern MAZDA fluorescent lighting. For more and more municipalities are proving that an investment in MAZDA street lighting equipment pays handsome dividends by increasing public safety and enhancing civic pride. For advice on every kind of lighting problem consult BTH Lighting Advisory Service, Bridle Path, Watford, Tel: Watford 7701/8. London Showroom, Crown House, Aldwych, W.C.2. Tel: Temple Bar 8040. Ext. 242.

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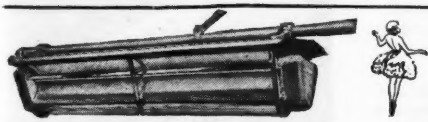


The first of its kind

Mazda 3 - lamp street - lighting lantern (SLA750) as used in the Old Bond Street (illustrated above) and Kingsway installations in London.

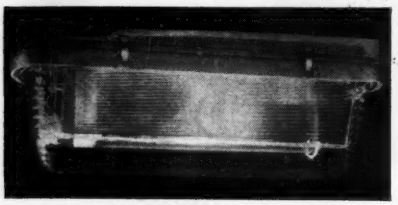
THE BRITISH THOMSON-HOUSTON COMPANY LIMITED, CROWN HOUSE, ALDWYCH, LONDON, W.C.2

M4246

LIGHTING FITTINGS

A new "Atlas" lighting unit by THORN ELECTRICAL INDUSTRIES, LTD., is intended for use in banks, department stores, cinema and theatre foyers, etc. It incorporates eight 4 ft. 40-watt fluorescent lamps in two rows on four sides of a square fitting behind diffusing screens and six 3 ft. 30-watt lamps above centre louvres. A feature of the fitting is that it avoids the dark areas often associated with fluorescent fittings. Since the fitting is normally employed for high mounting care has been taken to ensure that it can be easily maintained. The outer diffusing screens are easily removed to expose the lamps, and the central louvre tray may be dropped down on safety chains.

A new totally enclosed lantern for 85-watt or 140-watt sodium lamps introduced by THE GENERAL ELECTRIC CO., LTD., has a strong but light die-cast body to which the

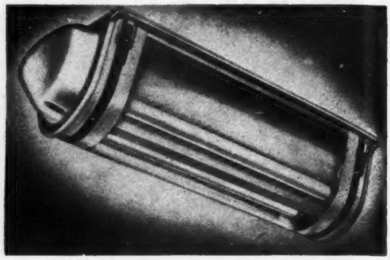


G.E.C. totally enclosed sodium lantern.

"Perspex" dish is clamped by a spring ring tensioned by quick-release toggle catches. The dish is therefore easy to remove, while the method of attachment, in conjunction with a felt gasket, forms a weather-proof joint when the lantern is closed.

Light control is obtained by "Perspex" refractor plates hermetically sealed to each side of the dish by a method that provides a permanent but almost invisible joint, so that there is negligible interference with the passage of light. The backs of the plates, like the external surfaces of the dish, are smooth to facilitate cleaning. Both ends of the dish are finished in a manner that provides a measure of light diffusion. The lantern body is stove-enamelled white inside to act as an over-reflector, and externally has a glossy aluminium finish.

A special form of "Perspex" is used in the dish that softens at a higher temperature than normal "Perspex." The resultant margin of safety is very desirable for lighting equipment used out of doors, where



Metrovick 'Borough' streetlighting lantern.

there is fairly constant heating from the sun in daytime and from the lamps and auxiliary equipment at night.

The METROVICK "Borough" lantern, designed for lighting Group "B" roads, accommodates two 40-watt 2 ft. type MCF/U tubular lamps and all auxiliary gear. The lantern framework consists of two cast silicon aluminium end-plates held rigidly in line by a 16 g. M.S. canopy and a ½ inch diameter steel tie rod. All steel parts have been suitably treated to prevent corosion. The end-plate at the "Road" end of the lantern has a blown "Perspex" wiring cover attached, which gives access to the mains terminal block. The optical system, consisting of two high grade polished aluminium reflectors, is protected by a clear "Perspex" cover, held in position by four toggle clips, which enable the cover to be easily removed for relamping and other maintenance purposes.

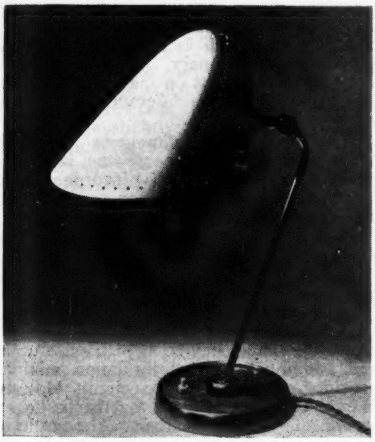
Illustrated below is a new fluorescent fitting by COURTNEY, POPE (ELECTRICAL), LTD. This is a general service trough made of opal "Perspex" which allows sufficient upward light to give good ceiling illumination. They may be used for either commercial or industrial lighting. The well-known

Amhurst opal 'Perspex' trough.

"Flouvre" fitting may be attached if required.

LINOLITE, LTD., announce the introduction of a range of "Linora" fluorescent reflectors for the lighting of showcase and shop window displays. They are designed for use with the 18-in., 2-ft., 3-ft., and 4-ft. bi-pin lamps. The reflectors are constructed from 22 s.w.g. hard-drawn aluminium and have a detachable steel wiring channel on which are mounted the lampholders and starter switch socket. The outside is finished in neutral bronze stove enamel. Prices vary from 49s. for reflectors for the 18-in. lamp to 67s. for those for 4-ft. lamps.

Included in these notes is an illustration of the table lamp version of the "Versalite" fitting by TROUGHTON AND YOUNG (Lighting), LTD. The "Versalite" fittings have been designed as a series to give maximum flexibility and adaptability for use in modern interiors. The series includes wall brackets, pendants, standard lamps, etc., which may be fitted either with reflectors of the type shown or with shades which are somewhat similar in shape, the top being open.



'Versalite' table lamp.

Trade Literature

THE SUN ELECTRICAL CO., LTD. Catalogue of industrial and commercial lighting fittings. Also catalogue of decorative lighting fittings in "Perspex" and brochure of flourescent lighting fittings, lamps, and auxiliary gear.

ELCONTROL, LTD. Brochure on aids to production, including photo-electric equipment.

SIEMENS ELECTRIC LAMPS AND SUPPLIES, LTD. Pocket price-list No. 972 and leaflet 994, both for electric lamps.

TUDOR ACCUMULATOR CO., LTD. Descriptive brochure giving technical details of "Saftylyte" emergency lighting equipment.

THE BENJAMIN ELECTRIC, LTD. Catalogue on industrial lighting equipment which is to be followed shortly by a new fluorescent catalogue giving full details of the complete range of Benjamin "Fluoroliers" and also auxiliary gear.

Situations Vacant

Personal

Mr. H. WIGSTON has been appointed sales director of the Electrical Division of the Britannia Engineering Company, of Luton. He served for many years with the B.T.H. Co., relinquishing his appointment with their lighting department in September last. In his new position Mr. Wigston will be concerned with developing lighting and other electrical business.

I.E.S. ACTIVITIES

London

At the London meeting on December 13 a paper of this title was given by Mr. W. A. R. Stoyle and Mr. G. D. Jones-Thomas.

The rapidly expanding use of fluorescent lamps and the present range covering lengths from 18 ins. to 8 ft. and wattages from 15 up to 125, make it very necessary for those concerned with maintenance and servicing to have a thorough knowledge of their various characteristics.

Unlike the tungsten lamp, control gear is an integral feature of the fluorescent lamp, and to run a fluorescent lamp at its maximum efficiency the correct gear for the lamp concerned and the mains supply available must be used. By the use of correct control gear, lamps will run at their maximum efficiency and give a satisfactory life. For example, the 5-ft. 80-watt lamp has a starting current of 1—1.6 amps., below this figure incorrect cathode heating will occur and above this limit too much current will pass. In both cases lamp life will be adversely affected. This lamp should run at a current of 0.85 amp., and on an arc voltage of about 106 volts in order that the maximum amount of ultra-violet radiation is generated and maximum lamp efficiency is obtained.

Fluorescent lamps are quite sensitive to variation of mains voltage; the general effect of undervolting is decreased light output and uncertain starting, while considerable overrunning will reduce the life. The correct running and correct light output is also affected by surrounding air temperature. The lamp is designed to function correctly when the bulb temperature is about 50 degs. C. and the surrounding air temperature about 20 degs. C. Suitably designed fittings for use in low temperatures and well ventilated fittings for use in high temperatures must be used.

All discharge lamps, when run on A.C., have a non-uniform light output as the light drops almost to zero at each half-cycle. This would produce a flickering effect if it were not for the after-glow of the fluorescent powder which helps to reduce this effect and in most installations is not noticeable. However, where rotating machinery is in use, the effect can give rise to peculiar optical effects, such as making gear wheels appear to be stationary. This can be overcome by using lamps on the "twin" circuit, or by using lamps on different phases of the supply.

The essential components of the fluorescent lamp circuit are the lamp, the choke, the starter switch incorporating a radio interference suppression capacitor and a power factor correction capacitor.

Capacitors are made for both parallel power factor correction and for series operation in capacitive circuits. The capacitor for series operation is considerably larger than those used for parallel correction as the voltage developed across them in the capacitive circuit may be as high as 350 volts and additional internal insulation must be provided. The capacitive circuit plus the inductive circuit operated together is known as the "Twin" lamp circuit. The results of operating in this manner are that, because of a 60 deg. lag and 60 deg. lead circuit,

Kenneth Horne officiating at the I.E.S. 'Brains Trust' meeting on November 23rd. *Left to right*—J. G. Holmes, N. C. Slater, Kenneth Horne, L. H. Hubble, R. O. Ackerley. The meeting was probably the most successful London Informal Meeting for some time.

power factor is practically unity, and the lamps will be at minimum light output at different times. This helps to smooth out the flicker mentioned earlier.

Recent developments are the series circuit, the instant start circuit, and the 8-ft. lamps with associated gear. The low lamp voltage of the 24-inch 20-watt and 18-inch 15-watt lamps makes them suitable for series operation on 200/250 volt supplies from a single set of control gear. The instant start circuit dispenses with the starter switch, but a transformer is used in addition to the choke, etc., to provide cathode heating. As far as the lamp is concerned, a standard lamp is used but with the addition of a strip of wire fixed along it and soldered to the caps. In order to ensure reliable starting this strip must be earthed.

The 8-ft. 125-watt lamp can be used on D.C., but a series resistance and a polarity reversal switch are necessary. The resistance of correct value is used because the resistance of the choke is very small on direct current. The purpose of the reversal switch is to counteract the tendency of mercury migration towards the cathode on D.C. Starting is slightly more difficult than on A.C., but life is unaffected and stroboscopic flicker and power factor problems are absent. Whilst colour and light output are the same as on A.C., the overall efficiency is practically halved due to the wattage loss in the resistance.

Those responsible for testing and maintenance must be familiar with fault symptoms and able to diagnose troubles. To assist them and to save a considerable amount of time, a test set is recommended in conjunction with a universal meter. This enables the starting current, running current, mains volts and lamp volts to be checked without disturbing the wiring of the fitting. It is essential to check these before proceeding with fault finding.

Birmingham Centre

The second sessional meeting of the Birmingham Centre was held at the Imperial Hotel on November 4. The lecturer was Mr. J. G. Holmes, the treasurer of the I.E.S. and a past chairman of this centre, who read a paper entitled "New Definitions and Units of Light."

In his introductory remarks the speaker pointed out that as recently as 1926 there were only two internationally adopted definitions. Twelve years later this had increased to 95, and in the near future a new glossary of terms used in Illuminating Engineering will contain something like 250 items. There had been a very full discussion on Terms and Symbols at the meeting of the International Commission on Illumination at Paris last year, and agreement had been reached on 14 terms and definitions.

Light was the first term dealt with, and Mr. Holmes said this was substantially the same as at present, viz., radiant energy capable of stimulating the eye so as to produce the sensation of vision.

Luminous intensity was next on the list, and here the speaker pointed out that the concept of a point source was rather silly in as much as that a point has no size, and therefore would have little or no light output. Modern light sources, whether a searchlight, an opal globe, or a fluorescent lighting unit, could not be regarded that way. The new definition of luminous intensity has now become "the solid angular flux density in a given direction," which is independent of the out-of-date idea of a point source.

Then followed a detailed description of the new reproduceable physical unit of light with a luminance of 60 candelas per sq. cm. The term candela replaces the new candle and is the unit of luminous intensity.

The word brightness has so many connotations that it was felt a new term was needed. Brightness in a photometric sense now becomes luminance and is the luminous intensity of the light emitted per unit, orthogonally projected, area of surface in a given direction. The word for subjective brightness, or the visual impression of luminance, is luminosity.

The use of the equivalent foot-candle was deprecated, and the recommended unit of luminance is the foot-lambert. Other terms were candelas per square inch, the stilb and apostilb.

The speaker noted that the word "illumination" related both to the process of distributing light and to the result of the process, the luminous flux density on the illuminated area, and he reiterated that the most satisfactory unit of illumination was the lumen per sq. foot.

Having covered the four basic concepts of illuminating engineering, the speaker referred to decisions made last year with regard to measuring the colour-rendering properties of light sources, i.e., the division of the spectrum into the eight bands and to relate the percentage flux to three standard illuminants. He then briefly dealt with the new definitions for local lighting, localised lighting, directional lighting, and general lighting.

There was a short but interesting discussion, and a vote of thanks, which was proposed by Dr. J. H. Nelson, was passed with acclamation.

Liverpool Centre

A party of 30 members of the Liverpool Centre recently went to Preston by coach to visit the Lamp Research Laboratories and the new fluorescent lamp factory belonging

to Messrs. Siemens Electric Lamps and Supplies, Ltd.

The Society's president, Dr. J. N. Aldington, who is Director of Research for Siemens and Deputy Works Manager of the Preston Lamp Works, received the members, who were then shown over the various laboratories which deal with lamp research and quality control. They also visited the general service lamp production and wire drawing departments.

The members then went to the fluorescent lamp factory which was fully described in the August issue of "Light and Lighting." The entire process of fluorescent lamp manufacture takes place under one roof—from the grinding and mixing of the powders and the manufacture of anodes and cathodes, to the finished lamp. The party was delighted to have the opportunity of seeing fluorescent tubes actually in production on a really modern mass scale and was most impressed by the ingenuity of the machinery and by the skill and care put into the manufacture.

The Liverpool Centre members would like to publicly express their appreciation of the courtesy of the directors of Messrs. Siemens, and to our president, Dr. Aldington, for all the facilities offered.

Huddersfield Group

"The Lighting of Road Transport Vehicles by means of Fluorescent Lamps" was the title of the lecture given to the Huddersfield Group, on Friday, December 2, 1949. The lecturer was Mr. H. B. Mellor.

The lecturer described the various types of electricity supplies available for transport lighting, and the typical equipment and circuit components necessary for each system. Comparable efficiencies and illumination values for each method were discussed in detail, and costs for each system compared, although it was stressed that cost alone should not be the chief consideration.

In the case of trolley-buses the track supply was usually in the region of 500 volts D.C., and a system of direct operation of fluorescent lighting using this supply had been evolved. This was the system which had been installed in two trolley-buses belonging to the Huddersfield Corporation Passenger Transport Department as a trial installation. The advantages of this lighting were higher lighting intensities, lower energy consumption (about half that for tungsten), better light distribution, and improved design of lighting fittings. Against these advantages the system used from the line voltage on D.C. had the disadvantages of extinction of the lamps when the trolley passed over the overhead section isolators, gradual darkening of the lamps due to operation on D.C. and higher initial cost and maintenance than tungsten lighting.

A more satisfactory system is the one which incorporates a small motor-driven alternator, the lamps then being operated from A.C. supplies. This system obviated extinction of the lamps at overhead isolators, but the disadvantages of causing end-blackening was rather more expensive.

Before the meeting started, a trolley-bus having fluorescent lighting had been placed at the disposal of members for inspection. Great interest was shown in the bus, as was

Members of the Liverpool Centre who visited the Siemens Preston works recently. On the extreme right are Mr. K. R. Mackley (Hon. Sec. of the Centre), Dr. J. N. Aldington and Mr. C. C. Smith (Chairman of the Centre).

evidenced by the number of members visiting the bus.

An invitation had been extended to the Huddersfield Corporation Passenger Transport Department staff to attend the meeting, and several visitors attended from this department.

At the conclusion of the meeting Mr. Mellor agreed that most of the present installations on transport vehicles were in the state of development, but great progress was being made, and Huddersfield, he said, was to be congratulated on being in the pioneer class in this matter.

Newcastle Centre

At a meeting of the Newcastle Centre on December 7, Mr. W. A. R. Stoyle gave his paper on the operation and maintenance of fluorescent lamp installations. (See p. 362 of this issue for a fuller account of the paper which was subsequently given in London.) The number of members and visitors present was 100—the largest attendance at the Centre's meetings for some time. The discussion was opened by Mr. Kingsley Lark who was followed by many others. The vote of thanks to Mr. Stoyle was proposed by Mr. J. S. McCulloch, vice-chairman of the Centre.

Forthcoming I.E.S. Meetings

LONDON

January 10th
Sessional Meeting. Messrs. R. G. Hopkinson and P. Petherbridge on "Discomfort Glare in Relation to the Lighting of Buildings." (At the Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.) 6 p.m.

January 25th
Informal Meeting. "Lighting in Other Countries." (At the Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.) 6 p.m.

February 14th
Sessional Meeting. Dr. J. W. Strange on "The Dimming of Fluorescent Lamps and its Application to the Theatre." (At the Lighting Service Bureau, 2, Savoy Hill, London, W.C.2.) 6 p.m.

CENTRES AND GROUPS

January 4th
Mr. L. C. Rettig on "Church Lighting." (At the Minor Durant Hall, Oxford Street, Newcastle-on-Tyne.) 6.15 p.m.

January 5th
Mr. L. C. Rettig on "Church Lighting." (At the Agricultural House, Queen Street, Exeter.) 7 p.m.

January 6th
Mr. L. C. Rettig on "Church Lighting." (At the South Western Electricity Board Showrooms, Bath.) 7 p.m.

January 6th
Annual Dinner. (At the Imperial Hotel, Temple Street, Birmingham.) 6 p.m.

January 6th
Mr. E. A. Langsdon on "Cold Cathode Lighting." (At the Electricity Showrooms, Market Street, Huddersfield.) 7.15 p.m.

January 9th
Mr. H. W. Cumming on "Rare Gas Lamps—the Gas Arc." (At the Lighting Service Bureau, 24, Aire Street, Leeds, 1.) 6 p.m.

January 11th
Presidential Address by Dr. J. N. Aldington. (At the South Wales Electricity Board Demonstration Theatre, The Hayes, Cardiff.) 5.45 p.m.

January 12th
Mr. F. Jamieson on "Display Lighting." (At the Demonstration Theatre, East Midlands Electricity Board, Leicester Sub-Area, Charles Street, Leicester.) 6.30 p.m,

January 12th
Mr. F. G. Copland on "Analysis of Lighting Problems in an Industrial Undertaking." (Joint Meeting with the Electrical Contractors Association, Manchester Area Branch.) (At the Reynolds Hall of the Manchester College of Technology, Sackville Street, Manchester.) 6 p.m.

January 13th
Symposium of Papers. (At the Imperial Hotel, Temple Street, Birmingham.) 6 p.m.

January 17th
Mr. D. L. Charters on "Recent Advances on Ophthalmology." (At the Lecture Theatre of the Merseyside and North Wales Electricity Board's Showroom, Whitechapel, Liverpool, 1.) 6 p.m.

January 18th
Annual Dinner. 6.15 p.m. Newcastle Centre.

January 18th
Mr. M. W. Peirce on "Industrial Lighting." (At the Y.M.C.A., Swansea.) 5.30 p.m.

January 18th
Messrs. S. Anderson and C. Dykes Brown on "Lighting of Trains and Public Service Vehicles." (At Cleveland Scientific and Technical Institution, Corporation Road, Middlesbrough.) 6.15 p.m.

January 19th
Brains Trust. (At the Yorkshire Electricity Board, 45/53, Sunbridge Road, Bradford.) 7.30 p.m.

January 25th
Mr. W. D. Sinclair on "Street Lighting." (At the Welfare Club Hall of the City of Edinburgh Lighting and Cleansing Dept., High Street, Edinburgh.) 7 p.m.

January 26th
Mr. W. T. F. Souter on "Lighting of Public Buildings." (At the East Midlands Gas Board, Demonstration Theatre, Parliament Street, Nottingham.) 5.30 p.m.

January 26th
Messrs. W. D. Sinclair and G. K. Lambert on "Exterior Lighting by Fluorescent Lamps." (At the Institution of Engineers and Shipbuilders in Scotland, 39, Elmbank Crescent, Glasgow, C.2.) 7 p.m.

February 1st
G. W. Golds on "Railway Lighting." (At the Minor Durant Hall, Oxford Street, Newcastle-on-Tyne.) 6.15 p.m.

February 2nd
Mr. A. L. Randall on "American Lighting Trends." (At the Agricultural House, Queen Street, Exeter.) 7 p.m.

February 3rd
Mr. A. L. Randall on "American Lighting Trends." (At the Grand Hotel, Bristol.) 7 p.m.

February 3rd
Mr. A. B. Nutt on "Visual Fatigue." (At the Electricity Showrooms, Market Street, Huddersfield.) 7.15 p.m.

February 6th
Mr. H. L. Privett on "The Latest in Electric Lamps." (At the Medical Library, The University, Western Bank, Sheffield, 10.) 6 p.m.

February 9th
Mr. J. N. Hull on "Transport Lighting." (At the Demonstration Theatre, East Midlands Electricity Board, Leicester Sub-Area, Charles Street, Leicester.) 6.30 p.m.

The EDITOR Replies

It is not surprising that the existence of spectrally different general service fluorescent lamps has provoked discussion as to which of the available types is the most satisfactory, and whether, in fact, there should be only one type or several. More than one question on this subject was addressed to the "Brains Trust" recently arranged by the I.E.S. in London. The development of the present colour range has been prompted partly by differing user requirements in the matter of colour rendering, and partly, we imagine, to explore public taste so as to determine whether, for all ordinary purposes, perhaps a single colour can be found eventually which meets with almost universal approval. No doubt if *everybody* is to be satisfied a variety of lamps is needed, and fluorescent materials give lamp makers the means of satisfying every taste, although at the higher cost involved by variety instead of uniformity of product. But we do not think the quest for one colour-type of lamp suitable for standardisation for general service will be a long or a hopeless one.

The mixture of different colour-typed fluorescent lamps to be seen in some buildings, and the difference often seen between adjacent buildings in which lamps of the same colour are not used, is tending, we think, to popular dissatisfaction, and it will be unfortunate if any such dissatisfaction becomes associated with fluorescent lighting as such, instead of only with discordant colour practice. Moreover, the present range of colours, when seen simultaneously, do not present a colour harmony, nor do they have any of the pleasing effects produced by the variously coloured lamps used for spectacular illuminations.

Our own preference is definitely for the "natural" lamp for all ordinary purposes. This is not the most efficient of the present fluorescent light sources, but luminous efficiency does not override all other considerations determining the choice of a light source.

We have been asked what is the best method of lighting for the purpose of cutting very thin sections of animal tissue for microscopic examination. The tissue has to be embedded in wax before the sections can be cut by a microtome. Slices are then cut from the block of wax and not until a number of slices have been made is the embedded tissue reached. The problem is to see when a piece of tissue first appears in a slice of wax and, when the tissue is not pigmented, there is practically no colour contrast between it and the surrounding wax, so that it is very difficult to detect the presence of any tissue. On this account sections are sometimes wrongly discarded because they appear to consist only of wax. But the tissue reflects light diffusely, while the wax is a specular reflector; so, if the light illuminating the sections is suitably directed, adequate brightness contrast between tissue and wax can be produced. Good general lighting is not effective for this work. The best result is obtained by using a local lighting unit so arranged that the direction of the light is similar to the direction of viewing the sections. In practice it is found satisfactory to use an adjustable floor stand unit placed behind the operator so that light comes over the left shoulder on to the work.

The reintroduction of a correspondence column into the journal with the last issue did not pass without comment. The majority of readers are glad to see it back. We hope that in time readers will get into the habit of expressing their views through the medium of LIGHT AND LIGHTING.

LIGHT AND LIGHTING

32, Victoria Street, London, S.W.1. Telephone: ABBey 7553

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